A Work Project, presented as part of the requirements for the Award of a Masters Degree in International Management at

NOVA School of Business and Economics

"Macroeconomic and microeconomic determinants of non performing loans in the Italian banking system"

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Abstract

During the last years, we witnessed a gradual decline of bank's assets quality. One of the best tools used in order to estimate the economy state of health is the level of non performing loans (hereinafter, NPLs). The first part of this study is focused on the Italian banking system and the results are consistent with the existent literature (Greece, Spain, etc.) showing an important impact of GDP, unemployment rate, size and solvency variables. The second section investigates on the impact of the crisis without any remarkable finding. The last one identifies big banks as more affected by NPLs level.

Keywords: Non performing loans, Italy, macro and microeconomic factors, data panel

1. Introduction

As explained by Beck, Jakubik and Piloiu in the European Central Bank paper of 2013, it's known that level and ratio of deteriorated credits depend of economic cycles. However, this degeneration has been inconstant over the Eurozone countries: an analysis on macroeconomic and microeconomic factors that led the proliferation of these non performing loans might better specify this irregular path. The information regarding the former are often taken into consideration as key measure of credit risk (Jakubik e Sutton 2011) which is often correlated with a poor banking system performance: given its importance in the global economy, the loan quality may be taken as a good proxy of the business cycles (Quagliariello 2007).

The NPLs are defined as "loans not held for trading that are past due by three months and/or as loans, with no collateral considered, characterized by a debtor who is likely to default and hence not able to pay back the credit obligations in spite of any past-due amount" (European Central Bank 2016). Anyways, it does not necessary mean that all the value is going to be completely lost once a loan is defined as non performing: in the first case, the recovery ratio might be

slightly higher than 0% or even 100% if the collateral involved is enough capacious to cover the total debt value; in the second one, the debtor's status may change during the time and the considered loss may not emerge. As stated before, this type of credits is physiological. The problem occurs when the level of NPLs exceeds a certain amount preventing banks to earn profits, providing new loans and hence new credit injections to companies. The above mentioned mechanism makes the economy entering a vicious circle if spread on a large scale over many banks and many banking systems: a conspicuous number of credit defaults reduces the available loans, decreasing the consumption.

The decision of studying the Italian banking system derives from the incredible level of NPLs compared to other European countries (€198 billions, more than three times the European average): the higher risk attributed by the market already halved the market capitalization of the sector. Furthermore, given that 33% of the total NPLs of the Eurozone refers to Italy (as revealed by a recent analysis performed by Unicredit), the fact that the market goes short on Italian bank equities should not surprise.

This study, partially follows the research conducted by Louzis, Vouldis and Metaxas on the Greek bank system who used annual data of the nine biggest banks from the first quarter of 2003 until the third one of 2009. Differently from them, the data set employed is unbalanced and made of annual observations. While they divided the sample in mortgages, business and consumer loans, this research does not differentiate among different loan typologies but among different time periods and sizes. The Italian banking sector has been observed by Quagliarello between the 1985 and 2002 through an analysis on banks' behaviour and economic trend.

The paper is split as follows: the first part presents an overview over the past literature and the factors taken in consideration; the second section describes in details the dataset used and the econometric model applied to the latter. The following one shows the results of the research while the last part concludes and summarize the main findings.

2. Literature Review

The focus of this paper is on four main topics: geographical area, macroeconomic environment, banking system characteristics and econometric model. This is neither the first analysis based on the Italian banking system (Quagliarello performed different studies before), nor the first one that takes into consideration macroeconomic variables (the past literature is overflowing). In addition, microeconomic analysis and the use of data panel have already been studied (Louzis, Vouldis e Metaxas 2011). However, to our best knowledge, there is not any study that meet all of the four criteria together.

The first part of the literature review is focused on past works based on country specifications, the second one on previous researches concerning macroeconomic factors explaining briefly each of them; the last one is based on the key bank specifications previously studied.

2.1 Country specifications

The major part of the past literature bases itself on country specifications. For instance, Salas and Saurina (2002) deeply analysed loan related issue affecting commercial and savings banks in Spain, finding that credit risk is mainly associated with individual microeconomic factors, such as bank size, interest margin, capital structure and market size, in addition to real GDP growth. Quagliariello (2007) looked at the Italian banking system analysing banks' behaviour over the economic and business trends. The paper tries to investigate whether losses from trouble loans, NPLs and ROA have a cyclical pattern concluding that banks' riskiness and profitability are affected by the evolution of the business cycle. A multivariate co-integration framework has been used in order to examine the connection and/or the casualty between lending rates and property prices in Hong Kong (Gerlach e Peng 2005). They conclude that property prices are determinant in the assessment of banks lending rates while the opposite seems not to be true. Moreover, the results indicate that lending rates in Hong Kong were not

the sources of the boom and bust cycle of the property market. Recently, the Mexican banking sector has been studied with the aim of estimating default frequencies and macroeconomic connections (Balvy e Souto 2009). More recently, Louzis, Vouldis and Metaxas (2010) examined the determinants of NPLs in the Greek banking sector finding that credit quality among Greek banks can be explained mainly by macroeconomic fundamentals and management practices (Beck, Jakubik e Piloiu 2013). Italy has been chosen due to the increase of non-performing loans during the last years [see Exhibit I]. Moreover, the recent economic difficulties of Monte dei Paschi (MPS) that almost drove one of the oldest banks in the world to bankruptcy, had a huge impact on the national opinion, making NPLs a trend topic on the national level.

2.2 Macroeconomic factors

The current and past literature is full of macroeconomic analysis pertaining to the NPLs evolution. GDP (in different forms), inflation, unemployment rate, real long term interest rates, net lending/net borrowing rates, saving rate, sovereign debt, currency exchange rates, etc. have been tested over the time. In this study, the main factors taken in consideration are the *GDP per capita*, the *unemployment rate*, the *long term interest rate* and the *net lending/net borrowing balance*.

GDP change has been tested many times and in different forms: Tanaskovic and Jandric (2015), for instance, took it into consideration along unemployment rate, interest rates and real estate prices when analyzing the economy slowdown that supposedly entails an increase in the number of NPLs due to debtors' difficulties in paying back loans. The evolution of the economic cycle (measured by the GDP growth) affects banks return since credits losses undermine banks profits reducing the loans concession (Quagliarello e Marcucci 2008). Another study performed by Quagliarello the previous year, strengthens this fact: he observed the Italian banking sector

between throughout 17 years, analysing banks' behaviour and economic trend. He verified that loans provision and returns follow a cyclic pattern demonstrating the GDP centrality and positive correlation while estimating NPLs on a long run. A comparable study (1989-2004) focused on the impact of debt, income, inflation and unemployment rate on NPLs has been performed showing a negative correlation between income and NPLs and a positive one for all the other variables (Rinaldi e Sanchis-Arellano 2006). However, the same study performed between the 1998 and the 2004 gave different results (a lower income coefficient) implying that an increase in the income level was not sufficient to explain the increase in debt on a short term horizon. With similar results, Ozili (2015) explored upward economic trends and noticed that banks extend credit lines easier, without conducting deep and further analysis on debtors' quality. The explanations provided differ based on the time horizon: in the short term an increase in GDP measured as growth rate should involve a decrease of the NPLs level due to the higher income available to creditors and hence an improved capacity of re-payment. However, on the long term, a continuous increase of the GDP lowers credit analysis due to the favourable climate and encourages people to borrow even when unnecessary or when lacking financial stability. The hypothesis of this paper is to prove a positive correlation due to GDP measure chosen (GDP per capita).

A positive correlation characterizes also NPLs and interest rates: for every increase in debt values given by a raise in interest rates, there is a boost in NPLs level (Messai e Jouini 2013). The same result has been found out by Espinoza and Prasad (2010): low growth rates and high interest rates increase the NPLs volume (the study has been run between 1995 and 2008 over 80 banks among Persian Gulf countries). Based on these assumptions, we expect to confirm this correlation.

Further analysis in the literature pointed out the role of the families and nothing is more important that being actively employed in this case: the deregulation of financial markets and

improvements in the technology involved in information systems together with the interest rates reduction led to higher efficiency, to lower transaction costs and, most important, to an increase in credit demand from families (Prasad e Espinoza 2010). The unemployment rate is highly correlated with the latter: both are key variables since the delay in payment is often indicative while assessing the likeliness to repayment and it can be viewed as a good proxy in measuring familiar financial stability (Laeven e Laryea 2009). A higher credit availability might increase family's financial resources and consumption but, at the same time, a high indebtedness may have a negative impact on future consumption (Laeven e Laryea 2009). Obviously, in order to meet each payment date and to not get insolvent, being employed is crucial: especially when committed in loans with a long term horizon such as mortgages, the unexpected loss of job undermines the likelihood of repayment. For this reason, a positive correlation between unemployment rate and NPLs level is expected. Rinaldi and Sanches-Arellano while analysing the roots of the non performing loans in the household's sector, found an interesting correlation between NPLs and net lending rate. The same variable has been studied by Louzis, Vouldis and Metaxas and it might be seen as a hybrid between macro and micro environments since the lending policy is not always driven just by the risk attitude of the banks (it is often distorted by internal incentives). Consequently, with an increase of NPLs, the bank system may cut loan concession off, decreasing liquidity and hence lowering the consumption impacting the overall economy level. The expected correlation of this variable is supposed to be positive considering the chosen measure of NPLs.

Besides the choice of these four variables, the literature presents many more analysis. Louzis, Vouldis and Metaxas considered the sovereign debt as a key factor: in this work, it has not been considered since it seems to be more appropriate for the Greek situation rather than for the Italian one. Another not often considered variable is the exchange currency rate. However, there is a reason if it is not mentioned in most of the analysis and researches on the topic: its variation

is not statistically significant when compared with the other variables (Buncic e Melecky 2012). This is given by the double effect on the depreciation since the positive one related to the income is offset by the negative one related to the balance of payments. A weaker currency should have a positive impact as a result of an increasing export and hence of a stronger repayment capacity from debtors. This scenario is likely to change during a financial instability period: the same debts might increase considerably.

Inflation has been often considered through many papers. As stated by Nkusu in a study from the 2011 performed on 26 different economies from the 1998 to the 2009, the inflation rate might have either a positive or a negative impact on the debtors' capacity to pay back their obligations. From one hand, it can lower the debt value "helping" borrowers' situations; from the other hand, inflation is also likely to reduce the income when wages are not adjusted by it. Furthermore, Buncic and Melecky proved that its increase leads to a higher NPLs level. However, in contrast with this analysis, an analogous one presented by Makri, Tsagkanos and Bellas in the 2014 on 14 different countries within the Eurozone between the 2000 and the 2008, shows that the inflation rate does not affect the NPLs. In this context is hard to clearly estimate the variable behaviour, for this reason it has not been taken in consideration.

Table 1: *Definition of variables tested.*

Variable	Indicator	Frequency	Measure	Hypothesis tested
Gross Domestic Product	GDP	Annual	Euro per capita	(+)
Unemployment Rate	UNEMP	Annual	Growth rate	(+)
Long Term Interest Rates	LTINT	Annual	Percentage per annum	(+)
Net Lending/Net Borrowing	NLNB	Annual	Percentage of GDP	(-)

2.3 Microeconomic factors

In order to have a more complete understanding of the phenomenon, microeconomic variables should be taken into account. Macroeconomic factors are not able to fully explain the NPLs development because most of the time the endogenous characteristics of the banking system such as cost structure, risk management and/or resources allocation, play a critical role influencing the general economy. In the 1997, Berger and DeYoung pointed out the impact of bank characteristics such as “bad luck”, “bad management”, “skimping” and “moral hazard”. These factors are often a bad signal which amplifies the negative effect of the additional costs (entailed by the overdue credits) on the banking cost efficiency. In this paper, *return on equity (ROE)*, *inefficiency, solvency* (which correspond respectively to bad management, skimping and moral hazard hypothesis), *size, leverage* and *diversification* have been included in the analysis.

The bad luck hypothesis is founded on external occurrences that impact banks loans. The relation between these events and the related costs is particular since the majority of the duties occur some time after the loans get overdue: these costs will lower the cost efficiency just in appearance because even the most efficient banks will have to deal with an increase of expenses related to NPLs. Given the nature of this variable and the aim of this research, it has not been further considered.

The difference between bad luck and bad management is essentially the timing. In this case, the increase in costs and the following decrease of cost efficiency take place before the raise in NPLs since the latter is the direct consequence of the bad management. The hypothesis was calculated with the analysis of the ROE and it is supposed to be negatively correlated with NPLs.

Skimping hypothesis has a similar pattern, meaning that the timing is the same as for the bad management; the revealing signal is opposite though (high cost efficiency due to the unequal

resource allocation). Under these assumptions, the management is driven by the desire of a short term high cost efficiency to the detriment of a long run good performance: the bank appears to be efficient because of the low expenses addressed to underwriting and monitoring loans. The ratio between operating expenses and operating income has been chosen and following what just mentioned above, it is supposed to have a positive correlation.

The last hypothesis taken in consideration by Berger and DeYoung is the moral hazard which implies an excessive risk-taking strategy when another part is involved and holds up the risk. It usually happens in banks with "limited" capital when a loss is suffered: this encourages the bank to increase the riskiness of its assets. This hypothesis is not strictly correlated with cost efficiency but still explanatory since it gives a solid alternative reason to the increase of NPLs and it emphasizes the effects of the three previous hypothesis (Berger e DeYoung 1997). In order to capture this variable, the ratio between Tier1 and total assets has been used: the expected correlation is negative.

Beside the ones given by Berger and DeYoung, Louzis et al. formulated four more hypotheses: "diversification", "too big to fail", "procyclical credit policy" and "tight control". Only the first two have been considered.

The first one takes into consideration banks' diversification since it can easily be connected with loan quality. Most of the previous literature considered the bank size as a good proxy for diversification since a big size is supposed to increase the range of hedging opportunities (Salas e Saurina 2002). However, the non-interest income might be used as a better approximation in light of the fact that it can be seen as the management capacity to confide in different income streams: for this hypothesis a ratio between net interest income and not-interest income has been used. The correlation is expected to be positive.

Related with the moral hazard one, the authors developed the "too big to fail" hypothesis which finds its roots in loose governmental policies that allow big banks to take excessive risk. If

Boyd and Gertler (1994) found positive acknowledgement about the topic, Ennis and Malek (2005) were not able to confirm this theory with absolute certainty. This hypothesis has a better fit with the size variable compared to the diversification one; for this reason, in order to catch the significance, it has been decided to use the total assets value as good estimator with an expected positive correlation sign.

The procyclical credit policy specification is based on the bank attempt to hide losses in the short term, in order to not affect the earnings, through different practices such as lending new money or extending deadlines to "problematic" borrowers (Rajan 1994).

The ownership dispersion is the last variable taken in consideration. A high ownership concentration is expected to decrease the NPLs level since all the risk is bore just by one subject which is supposed to be less willing to take huge risks compared to a situation in which the ownership (and then the risks) are divided by several subjects (Berle e Means 1932). None of the last two were considered due to different reason: in the first case it has been hard to evaluate a correct estimator. Louzis et al. used the ROE value which seems to be too simple though. In order to use this factor, a better understanding of the balance sheet has to be done.

In the second case, the Italian frame is not the most appropriate context where to perform such an analysis. First of all, the company structure is highly fragmented and it would be too difficult and vague to estimate a justifiable threshold. For instance, taking in consideration just the four biggest bank, there are not shareholders with a stake over the 10%. In details, Unicredit has a Aalbar Luxembourg and BlackRock as major shareholders with a 5% respectively. Intesa San Paolo boasts "Compagnia San Paolo" as primary shareholder with a 9,8% stake. UBI Banca presents Silchester International Investors with a 5% stake and Monte dei Paschi di Siena shows the Italian Financing Ministry as main shareholder (5%).

On the top of these criteria, a further hypothesis has been tested: in order to understand how the leverage of each bank affects the bad loans, the ratio between total assets and total liabilities

has been analysed. The expected correlation is supposed to be negative as the increase in assets (or the decrease in liabilities) drives the leverage down.

Table 2: *Definition of tested variables.*

Variable	Indicator	Frequency	Measure	Hypothesis tested
Inefficiency	INEFF	Annual	$Op.Expenses/Op.Income$	(+)
Size	SIZE	Annual	$Tot.Assets$	(+)
Diversification	DIV	Annual	$Int.Income/Non\ Int.Income$	(-)
Leverage	LEV	Annual	$Tot.Assets/Tot.Liab.$	(-)
ROE%	ROE%	Annual	ROE	(-)
Solvency	SOLV	Annual	$Tier\ 1/Tot.Assets$	(+)

3. Italian Context

The Italian environment is heavily affected by its economy which still struggles to recover. The government held by Gentiloni is trying to implement fiscal and monetary policies in order to foster the growth; anyways, inflation, weak euro and unemployment rate will be determinant. One of the main issue nowadays is the low demand coming from exports. The internal one is fortunately balancing the external one but for a country got famous for its "made in Italy" the situation is quite "heavy". The improvements in labour condition, negotiated recently by unions, and the higher household's disposable income, increased families' consumption.

Regarding the main macroeconomic values (see Chart 1), the real GDP grew by 0.83% in the 2016 and is expected to growth up to 1.03% in the 2018. The Inflation has been stable between the 2003 and the 2012, while it dropped afterwards due to the fall in energy prices. It has been negative during the last year but it is forecasted to increase at 1.1% in the 2017.

The unemployment rate has been stable around the 8% until the 2011, then it rapidly increased up to 11.7%; it is expected to decrease at 11.3% during this year however, it's higher than the average for the European countries. The household disposable income witnessed an increase in the last 3 years, setting its annual growth rate at 1.31%. At the same time, the household debt shows a decrease for the last 4 available years (not the 2016); however, it is still incredibly high if compared to the level of 10 years ago (66.2% of net disposable income compared to 89.2% of the 2015). If some macroeconomic values seem to start undertaking a positive path, the government debt set a record level in the 2016: it stands at 157.35% of the GPD, with a deficit of -2% [see Exhibit II].

Regarding the current Italian account surplus, it is expected to be set around 2%, higher than the European average. The investments are also expected to increase due to the ECB measures, taken with the aim to improve the overall credit accessibility in Italy.

In spite of these reassuring news, the Italian economic system is far to be recovered: the Constitutional Referendum of the last December made former Prime Minister Matteo Renzi resign, putting the Italian political environment in a context of total instability.

The banking system is going through some rough waters as well. According to the report "Italian banking sector: recent developments and reforms" published by the Ministry of the Economy and Finance in the 2016, the level of net NPLs hit the incredible amount of €198 billion, above the average level of other European countries. However, the aggregate value of NPLs has to be weight with the rates of debtor-collateral coverage which are higher in Italy rather than in other European countries.

In order to solve this problem, the Government intervened with several reforms on the governance and the structure of the Italian banking system. It has introduced GACS (Guarantee on Securitisation of Non-Performing Loans), the Atlante Fund and sponsored amendments on

bankruptcy aimed to speed up the legal processes and recover NPLs. Furthermore, it has implemented benefit regarding tax treatments of bad loans.

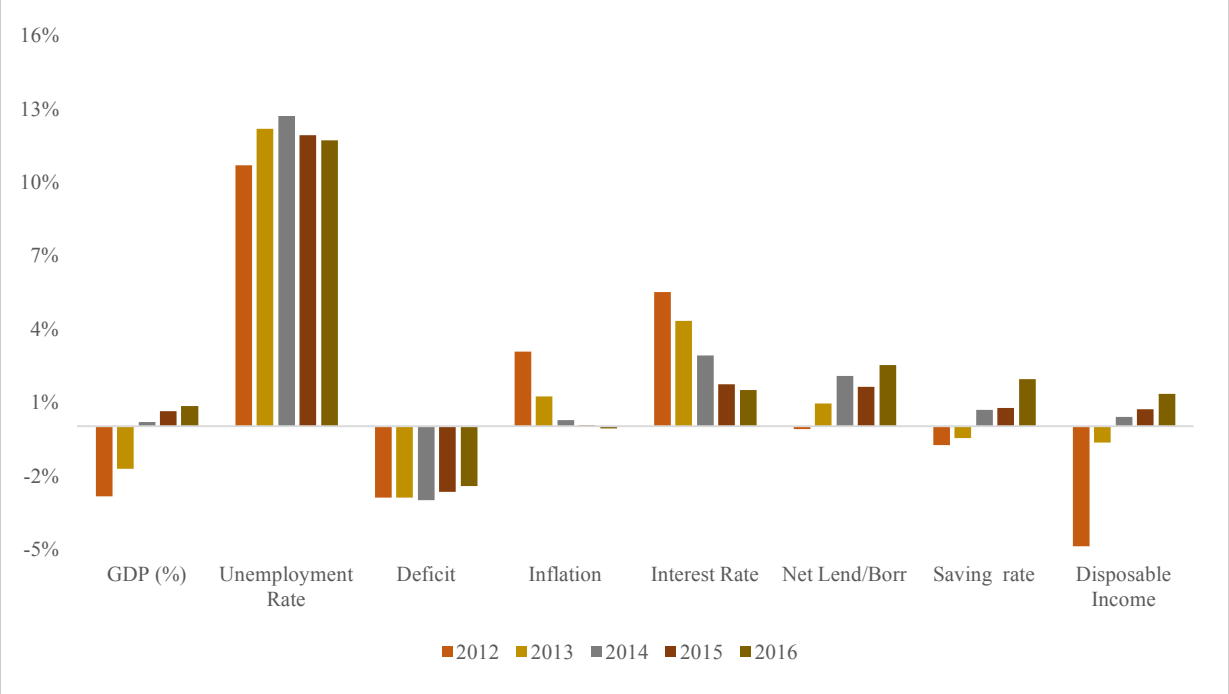
GACS is an instrument that the Ministry has made available to finance and credit operators with the aim of increasing the disposal of the non performing loans. The State guarantees only the senior debt and the price is settled by the market in order to avoid possible aiding and abetting that might affect the competition. At the end of last year, GACS has been able to close its first securitization deal with Banca Popolare di Bari. The portfolio comprised retail and corporate Bad Loans for a value of almost €480 million, of which €304 were loans mainly secured by residential and commercial properties, with the remainder being unsecured.

Atlante, originally called Alternative Investment Fund, is instead a private equity fund which gathers capital from financial institutions such as banks, insurance companies and foundations. The goals of this fund are mainly to ensure the success of the capital increases required to banks struggling on the market, to boost the NPLs Italian market due to the fact that Atlante will focus its investments in the subordinated debt tranches (there is a market for the Senior debt) and to offer to the investors high long term returns which will help the banking system, improving the overall Italian economy. During July of the last year, Monte dei Paschi di Siena has been evaluated as "the most fragile bank in Europe" by the EU. Suddenly after, it announced the plan of sale of 27.6 billion of bad loans at less than a third of the value (9.1 billion, equal to the 32.8% of the book value) which should have been bought by the fund. It did not work out at that time, but recently (10th of May 2017) Atlante finally closed it first operation: it bought 2.2 billion of NPLs from Banca Marche, Banca Etruria and CariChieti as essential condition in order to let UBI Banca proceeds with the acquisition of the three aforementioned banks.

Beside the governmental intervention, in order to increase the profitability, banks are working especially on the cost structure: only during the last year, 900 bank branches have been closed (to a total of 29,511). Unicredit estimated a possible reduction of the NPL ratio below the 14%

of the 2012 (today it is at 18%) only with a stable GDP annual growth rate of 1% given also the low interest rates that prevent the financial institutions from a massive increase in interest income.

Chart 1: *Italian main economic drive*



4. Methodology

The purpose of this Work Project is to analyse the impact that macroeconomic factors and bank specifications had on the NPLs level in Italy. Furthermore, the study wants to explore the causes of these impacts, trying to explain the mechanism that brought the Italian banking system to this point.

4.1 Research Questions

The questions this paper tries to address are the following:

RQ1: Which macroeconomic and microeconomic factors had the greatest impact on the non performing loans level in Italy?

RQ2: Which is the impact of the crisis on this topic? Did the parameters behaved constantly before and after the economic crisis that hit Italy in the 2008?

RQ3: Does the difference in size involve a different effect? Are big banks more capable in managing the non performing loans? Or being small entails a relatively low impact?

Table 3: *Descriptive statistics for NPLs of the last three years.*

	2014	2015	2016
Mean	€5.798.000	€4.226.000	€11.847.000
Median	€19.469.000	€16.550.000	€24.194.000
Max	€87.165.000	€77.838.000	€58.137.000
Min	€82.000	€47.000	€22.370.000
St. Dev	29,262	26,018	24,809
Skew	1,6071	1,6806	0,6124
Kurt	1,495	1,526	-1,899
JB test	6,282	7,948	1,7032
p-value	(0,043)	(0,019)	(0,427)

Notes: JB denotes the Jarque-Bera test for normality.

4.2 Data

Instead of comparing different countries as Nkusu (2011) and Betck et al. (2013), the paper focuses only on the Italian banking system due not only to the personal involvement but also to the fact that, with regards to bank specifications, the Italian context differs substantially from all the others. This decision is explained by the willingness to eliminate potential discrepancies among different European systems with regard to both economic and politic factors. In addition, only "pure" banks have been evaluated in order to have comparable results especially concerning operating income, interest income and non interest income values (for this reason, Banca Generali, the most important Italian insurance company, has not been included). In this

case, it would be particularly difficult whether to confirm or not some hypothesis such the diversification one: under these assumptions, it is easier to capture some results that otherwise would have not been clear.

The NPLs data are presented in absolute values and not in ratio with the total amount of loans. The decision has been made in order to differentiate the study from almost the totality of previous papers that used the aforementioned ratio and to monitor the supposed different behaviour (GDP is negatively correlated with the ratio of NPLs over total loans but it should be positive correlated with the absolute NPLs value).

Banks' information has been retrieved from Bloomberg and Thompson Reuters (EIKON) while the macroeconomic data has been taken from OECD (Organization fro Economic Co-operation and Development) database.

This study covers the following sixteen Italian banks: Intesa San Paolo (ISP), Unicredit (UCG), Mediobanca (MB), UBI Banca (UBI), Fineco Bank (FBK), Banca Popolare dell'Emilia Romagna (BPE), Banca Popolare di Milano (PMI), Banca Monte dei Paschi di Siena (BMPS), Credem (CE), Banca Popolare di Sondrio (BPSO), Credito Valtellinese (CVAL), Banca Carige (CRG), Banca di Desio e Brianza (BDB), Banca Profilo (PRO), Banca Finnat (BFE) and Banco di Sardegna(BSRP); data for Banca Popolare were unfortunately unavailable. These banks have been chosen for three main reasons: first of all, they are all listed at the primary securities market in Italy, the Milan Stock Exchange (in Italian, Borsa Italiana) meaning that all the data needed for this analysis are easily accessible. Secondly, since several variables have been tested, the sample has to be numerically consistent in terms of observations. Lastly, given the third question addressed, in order to compare the two sub-samples split with regard to the size, having several banks was absolutely necessary.

Concerning the timeframe, it spans from the 2004 to the 2016. The decision is based on the fact that, in order to capture the impact of the crisis and then to confirm or reject the hypothesis, the

sample has to be consistent before the 2009 and after the 2009. Through this arrangement, the subsamples are similar in term of years and both greater than 30 (even though the number of observations changes drastically due to unavailability of data for certain banks in specific years). Furthermore, taking into consideration just the recent years, it might result in unclear outcomes given by the possible distortion of the 2008 financial crisis which will not allow the study to be complete and comprehensive. Furthermore, because of the nature of the methodology, data before the 2004 and of the current year, has been disregarded due to lack of availability in the database used. The threshold used to divide the sample based on the size has been assessed to be €100.000 in assets which corresponds to the third quartile (consisting in Intesa San Paolo, Unicredit, Ubi Banca and Monte dei Paschi di Siena).

4.3 Econometric Framework

Given the nature of the regressand and its non-linear relationship with the regressors, a log-log model for panel data has been used. Logarithmic transformations are often used in order to transform highly skewed variables in approximately normal ones such the non performing loans case: the use of the logarithm makes the effective relationship non-linear maintaining the linear model (Benoit 2011). The use of data panel, instead, allows to check for variables that change over time but not across entities, monitoring for distortions deriving from individual heterogeneity and missing factors (Greene 2012).

Given the unbalanced data panel (the individuals of the data set are observed a different number of times, denoted with T_i), the choice of the right model was critical: due to the unobserved individual effects (heterogeneity), the Hausman test (1978) has been perform in order to decide whether to use fixed or random effects. The null hypothesis is that random effects are preferred while the alternative one suggests that fixed effects should be used: it basically tests whether the unique errors are correlated with the regressors or not. This test has been run on RStudio

and it showed a chi-squared of 19.297 with a significant p-value of 0.02278 which implies the rejection of the null hypothesis and the adoption of fixed effects in the model, which set time and banks effect with the goal to partially eliminate collinearity problems. In detail, bank fixed effects check for constant effects that might influence NPLs for a specific bank while year fixed effects keep constant the effects related in a given year that might affect the level of bad loans. In general, including fixed effects eliminates possible omitted variable biases (Imai e Kim 2016). The equation can be written as follow:

$$y_{i,t} = x'_{i,t}\beta + \alpha_i + \varepsilon_{i,t} \quad (1)$$

where $x'_{i,t}$ is the vector of explanatory variables, $\alpha_i = z'_{,}\alpha$ embodies all the observable effects specifying an estimable conditional mean and $\varepsilon_{i,t}$ is the stochastic error term.

Furthermore, given the particularity of the sample, namely the lack of data for specific banks and the relative small subsamples (namely, pre crisis and big size) a test for the multi collinearity has been performed using the variance inflation factor package within RStudio ($VIF = 1/(1 - R_k^2)$). This test presents a high correlation between leverage and solvency variables (values higher than eight): since leverage has been tested multiple times in previous researches and the results are quite clear, it has been preferred to keep the explanatory variable for solvency.

4.4 Model Specification

As previously stated, the regressors are the following: INEFF, SIZE, DIV, LEV, ROE%, SOLV, GDP, UNEMP, LTINT and NLNB. A second sequence of regression has been considered with explanatory variables for GDP and unemployment rate up to one lag (*Exhibit IX*). The model is presented as the following one:

$$log(NPL_{i,t}) = INEFF'_{i,t}\beta'_{1,t} + \log(SIZE'_{i,t})\,\beta'_{2,t} + \log(DIV'_{i,t})\,\beta'_{3,t} + \log(LEV'_{i,t})\,\beta'_{4,t} + ROE\%'_{i,t}\beta'_{5,t} + SOLV'_{i,t}\beta'_{6,t} + \log(GDP'_{i,t})\,\beta'_{7,t} + \log(UNEMP'_{i,t})\,\beta'_{8,t} + \log(LTINT'_{i,t})\,\beta'_{9,t} + NLNB'_{i,t}\beta'_{10,t} \quad (2)$$

For each sample and sub-sample (namely pre crisis, post crisis, big size and small size) macroeconomic and microeconomic variables have been tested first separately and then together in order to be parsimonious with the number of variables and to catch the difference of significance levels. Finally, the Breusch-Pagan test has been performed with the aim to detect heteroskedasticity (the variance stays constant for different observations), which has been found in several sub-samples: even though cross-sectional models are more likely to be interested by it, panel data might be affected as well given also the nature of the values. The presence of the latter does not affect estimates of β_i but rather the standard errors. In order to tackle this issue, a robust covariance matrix that is robust to heteroscedasticity in the errors has been derived (Greene 2012).

Further robustness checks have been performed with the goal of getting a deeper understanding of the variables. First of all, macroeconomic and microeconomic variables have been tested separately in order to catch the impact deprived of other variables "noise".

The second robustness check performed involved the use of lag variables with regard to GDP and unemployment rate. The base idea is that the two macroeconomic variables have a stronger impact when lagged due to the physiological adjustments of the business cycle that delay the effect.

5. Results

The estimations of the models that explain the development of NPLs due to change in the aforementioned explanatory variables are shown in the following table:

Table 4: *Results for main models.*

	GENERAL	PRE CRISIS	POST CRISIS	BIG SIZE	SMALL SIZE	
	[1]	[2]	[3]	[4]	[5]	
INEFF	0.00043	0.003085	0.00015	0.00328	0.00021	INEFF
	[0.00035]	[0.00424]	[0.000237]	[0.00222]	[0.00041]	
SIZE	0.66324**	1.44995***	0.198847	0.65351***	0.85498	SIZE
	[0.32793]	[0.37946]	[0.4821]	[0.22694]	[0.70886]	
DIV	-0.16192	-0.144744	-0.81483*	-0.68503***	0.31706	DIV
	[0.14283]	[0.23719]	[0.4416]	[0.23485]	[0.19096]	
ROE%	-0.28008	-0.594083	-0.06580	-0.30350	-0.61126	ROE%
	[0.33869]	[0.977426]	[0.21747]	[0.28297]	[0.53556]	
SOLV	-2.11117	24.58804***	0.664726	15.33724	-1.2176	SOLV
	[3.25469]	[5.35399]	[3.94346]	[15.66760]	[4.84488]	
GDP	5.12753***	3.361497	4.681425	4.25248***	5.84917***	GDP
	[1.51197]	[3.76980]	[4.21437]	[1.50651]	[2.05958]	
UNEMP	21.7665***	32.97039*	32.184379**	19.96231***	17.18808	UNEMP
	[6.76128]	[16.58389]	[14.84532]	[6.82526]	[10.20001]	
LTINT	2.49946	59.357438	0.078167	3.05891	2.63491	LTINT
	[4.12055]	[48.21316]	[3.98860]	[3.85786]	[5.67127]	
NLNB	-6.21770	4.552990	-9.520910	-14.9688***	-2.70753	NLNB
	[6.29012]	[19.038059]	[13.96892]	[4.67242]	[8.99781]	
R-sq.	0.59	0.43	0.47	0.88	0.53	
Adj. R-sq.	0.51	-0.09	0.29	0.83	0.42	
Observations	147	51	96	45	102	

Note: St. Errors are reported in parenthesis
*** denotes significance at 1%
** denotes significance at 5%
* Denotes significance at 10%

First of all, it should be clarified the fact that an explanatory variable without significance does not involve a complete lack of significance evidence but rather than the model is not able to capture it.

With respect to macroeconomic variables, as expected, GDP and unemployment rate are positively correlated with the increase of non performing loans in almost every scenario. The first one confirms the previous studies, playing an important role within the model with one substantial difference: the sign. While Beckmann et al. (2012), Louzis et al. and Jakubik and Reininger show a negative correlation, the estimation of this model is positive. As previously said, the different behavior is basically due to the different "form" of NPLs: it has been used in total values while previous researches considered the ratio on the amount of total liabilities.

It shows that an increase in the GDP per capita leads to an increase in the non performing loans and it is perfectly explained by the fact that higher incomes encourage consumption and new loans requests, which will automatically increase the level of NPLs.

Unemployment rate has a significant impact in all the samples taken into consideration confirming findings from previous papers such as Louzis et al. and Salas and Saurinas (2012). The fact that it has an immediate impact is also quite meaningful for research purposes: it entails a strong and quick repercussion on bad loans and should be carefully considered by regulators.

Long term interest rates cannot be confirmed as significant while the net lending/net borrowing hypothesis has a significant impact only in the subsample relative to banks characterized by a big size. This variable is measured as difference between loans and deposits as a percentage of GDP [see Exhibit X]. A positive value (as for the last years) indicates that big financial institutions are more willing to grant loans and probably pay less attention to the actual creditor situation. Hence, an increase in the lending rate broadens the pool of borrowers and the amount of non performing loans in turn.

On the other hand, with respect to the microeconomic explanatory variables, size is significant across all the models. This result might be brought back to the net lending/net borrowing one. Banks characterized by a big and relevant size have a loose internal control system in providing loans.

Diversification is highly significant up to a certain size [see Exhibit V] while inefficiency and ROE do not seem to be that statistically relevant. Bad management and skimping hypothesis are then rejected.

Solvency is characterized by an inconstant path, with a significant impact on NPLs' level just in the years before the 2009 [see Exhibit IV]. Moreover, it was supposed to be negatively correlated with the NPLs level while the sign is positive according to the results shown in Table 4. While the hypothesis, based on the belief that an increase in Tier 1 (and hence a more responsible management), would have led to a decrease in non performing loans, the outcomes reveal that the higher ratio of Tier 1 over the amount of total assets is likely to be caused by the NPLs value of the previous years. The moral hazard hypothesis as previously defined should be rejected, hence.

Overall, macroeconomic variables seem to be fairly constant (especially GDP and unemployment rate) across all the models while microeconomic variables vary based on the sample taken in consideration. Moreover, as shown in the Exhibits from III to VIII, inefficiency, return on equity and solvency result to be much more significant when not "disturbed" by macroeconomic variables which are probably somehow affected by GDP and unemployment rate.

The difference between the base model and the "lagged" one [see Exhibit from VI to VIII] surprisingly is not really marked; contrary to what expected, the explanatory variables seem to be more powerful when taken into consideration on the same year of the response variable. The only unemployment rate lag has not been considered due to the fact that it is directly correlated

with the GDP of year t and it would have entailed a distortion of the results of the small samples models (e.g. pre crisis and big size, weak due to the number of observations). With *n* equal to 51 and 45 respectively the use of 10 explanatory variables might seem to be forced since the ratio of 8-10 observations every variable would be shattered.

6. Conclusion

The study used unbalanced panel data to assess macro and micro factors that affect the level of NPLs in Italy. Even though the banks included in the sample are part of the same national banking system, they quite differentiate from each other especially with respect to size, return on equity and diversification of income. ID fixed effect might help capturing these differences but the specifications are likely to still affect the responsiveness to changes of variables. The model built for this study can be taken in consideration if the aim is to explain macro and micro economic processes that influence the Italian banking system. Applied to each individual bank, it might not work in the same way, involving room for improvement.

Overall, the main takeaways of this analysis are the positive confirmation of solvency, diversification, GDP and unemployment rate hypothesis and the rejection of inefficiency and long term interest rates hypothesis. With regard to the general effect on the level of non performing loans, GDP and unemployment rate result highly impacting among macroeconomic variables (perfectly in line with the previous literature) while only size and solvency are significant among the microeconomic ones.

The shock caused by the 2008 crisis has not yet been recovered with regards to the non performing loans. The difference between the pre-crisis and post-crisis samples suggests that nowadays, non performing loans are less responsive to changes in the economic environment since evidence of existence of the hypothesis tested are missing.

Conversely to hypothesised scenario, big banks are more “sensitive” than small ones: the reason

lies in the fact that smaller banks are able to manage the number of NPLs in a better way (probably due to the limited number) which makes them experiencing a lighter impact. As suggested by the results, in order to react better to this huge impact, big banks should pursue the diversification in income streams. This would lead to a lower negative effect of losses deriving from NPLs.

This study has some interesting implications in terms of regulation and policy: for instance, it suggests that regulators should pay much more attention to the most important and biggest banks present in the country. Moreover, labour and GDP growth policies should be fostered given the importance that embody in affecting the NPLs level.

For next researches, it would be advisable to study loans at specification levels (dividing them among different categories), in order to understand the determinants of being non performing. Furthermore, it might result interesting to add another banking system with a similar structure in order to compare the real weight of the bad (or good) management.

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